Energy Efficiency in Data Centers

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Critical Power and Cooling Services

Data Center Efficiency:

- **You can't manage it unless you measure it**

Developing data center energy audit tools for successfully measuring and benchmarking your efficiency performance

Controlling Electrical Costs

Social Responsibility

Reducing data center overheating

Releasing power and cooling capacity

Incentives

Regulations

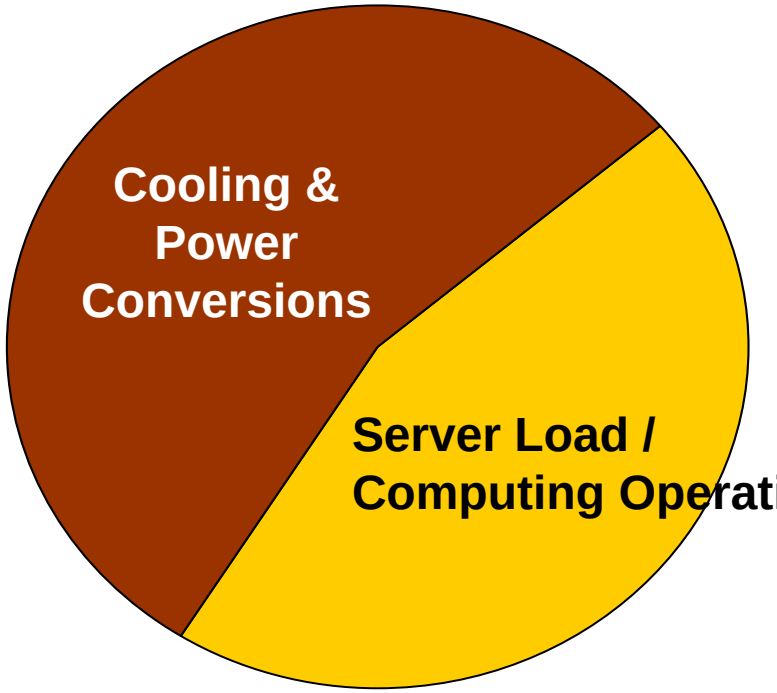
Fulfilling carbon commitments

Data centers: A big target

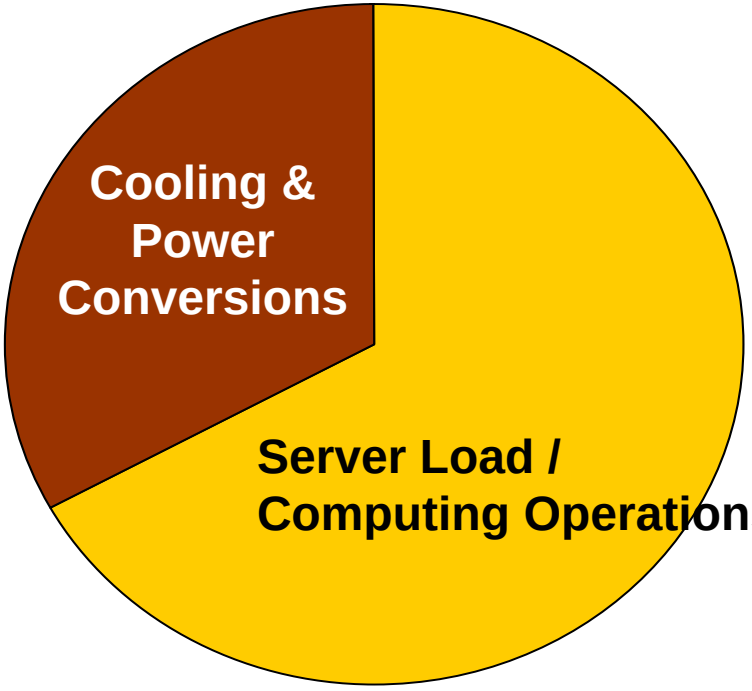
"We're going to get killed by our top management because we're the big power hogs"

"Data center energy efficiency hinges on utilization, not applications"
Robert Rosen, Columnist, SearchDataCenter.com
April 25, 2007

Data center cooling and power conversion performance varies

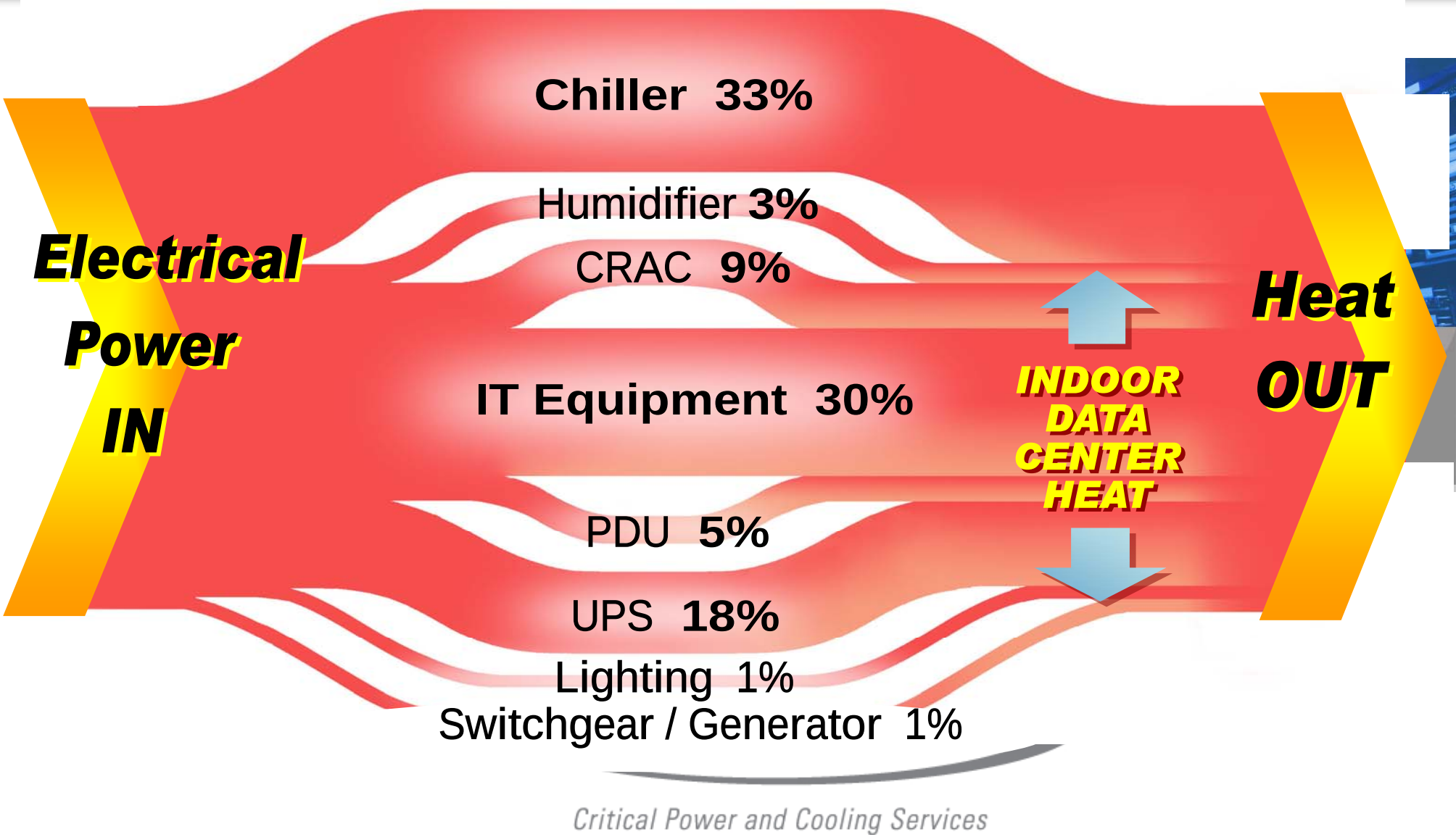


Typical Practice



Better Practice

Power flow in a typical data center



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Key reference points

- **More than 50% of the power going into a typical data center goes to the power and cooling systems – NOT to the IT loads**
- **A 1MW data center takes 177,000,000 KW-hr of electricity worth about $17,000,000 over its 10-year life (at $0.10 per KW-hr)**
- **Each data center MW is equivalent to about 4300 cars worth of carbon**
- **The typical 1MW data center is continuously wasting about 1000 cars worth of carbon due to poor design**
- **DOE estimates that we can save about 4,000,000 cars worth of carbon by 2015 by better data center design, equivalent to the electrical energy consumed by 1.8 million American homes**

Big drivers of inefficiency

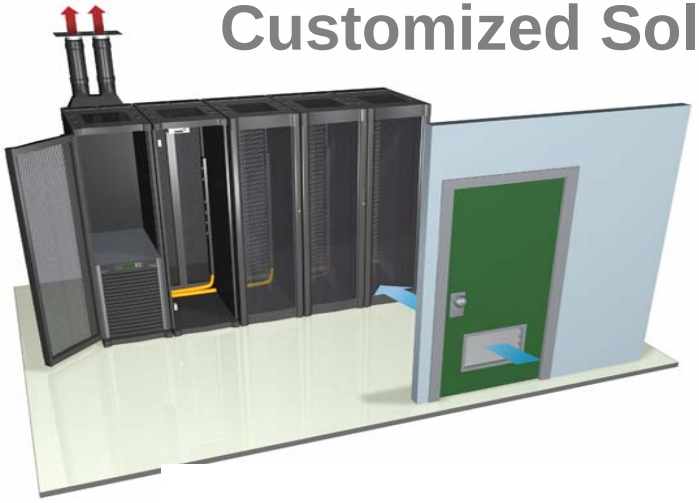
- **Oversizing of power and cooling equipment**
- **Pushing cooling systems to cool densities higher than they were designed for**
- **Ineffective room layout**
- **Ineffective airflow patterns**
- **Redundancy (for availability)**
- **Inefficient power and cooling equipment**
- **Inefficient operating settings of cooling equipment**
- **Clogged air or water filters**
- **Disabled or malfunctioning cooling economizer modes**
- **Raised floor clogged with wires**

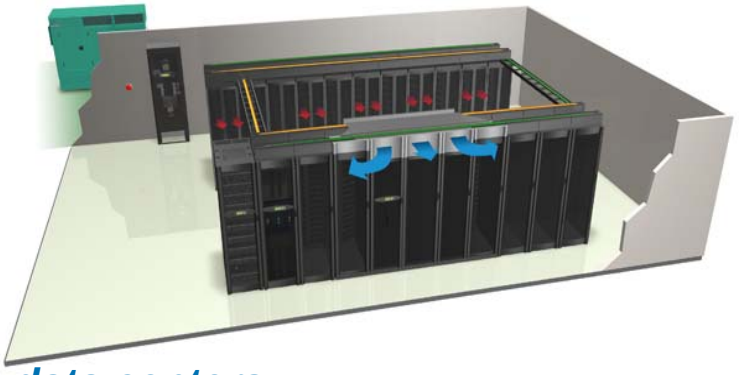
InfraStruXure™ Modular Systems

On-Demand Architecture for Network-Critical Physical Infrastructure (NCPI)

Pre-Packaged, In-stock Solutions

Customized Solutions





Changing the way the world designs data centers …

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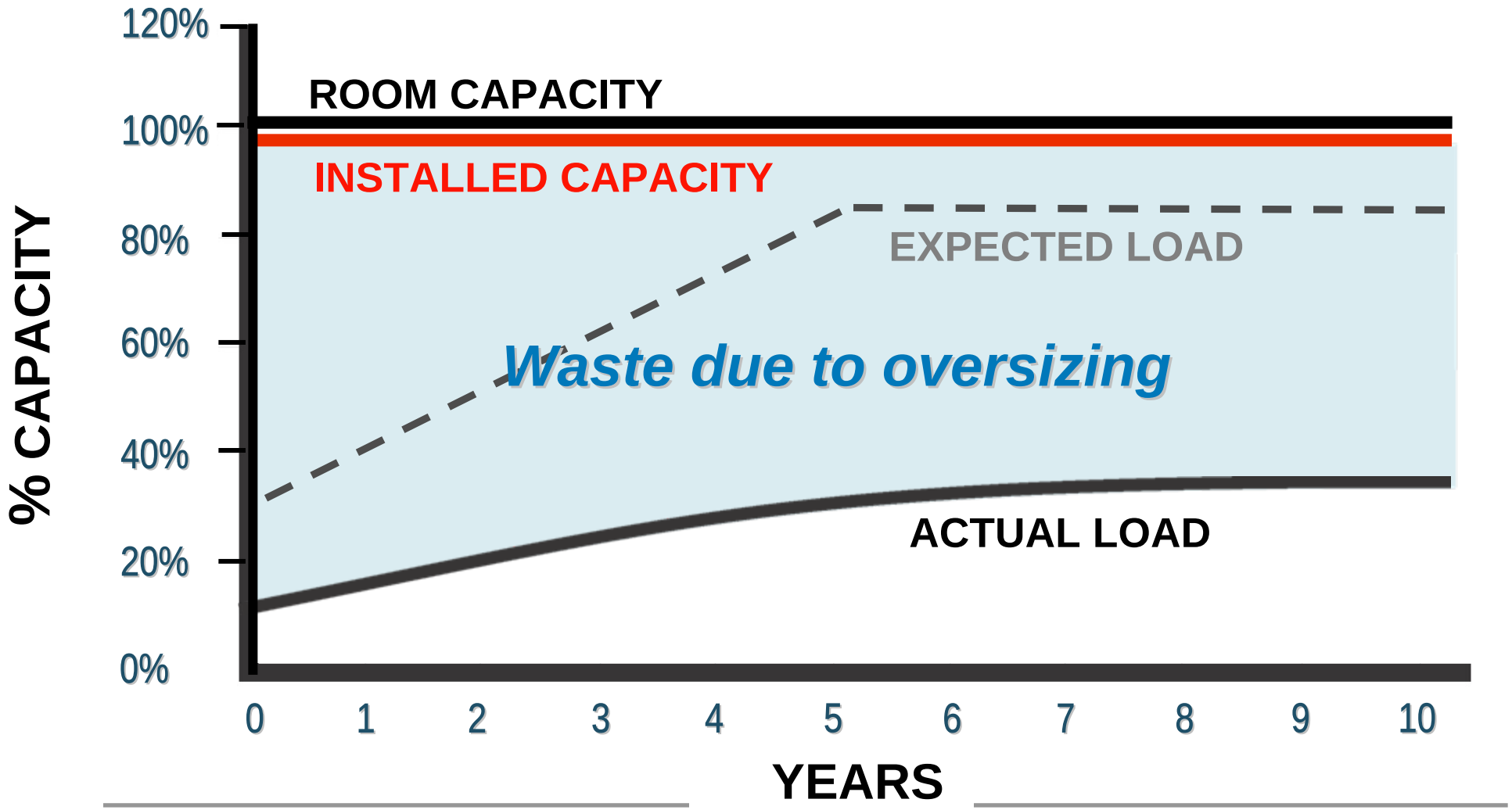
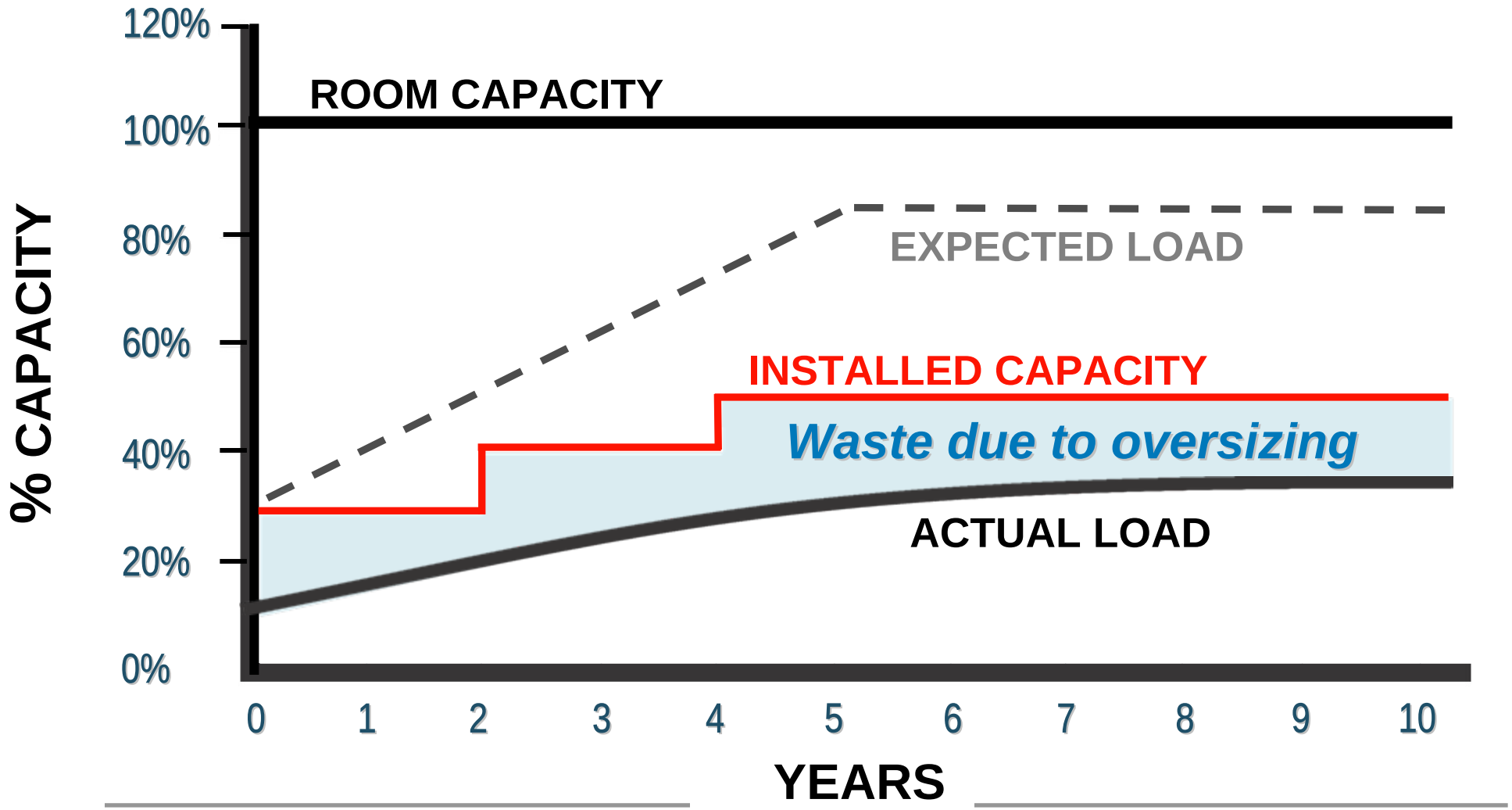
Waste Due to Oversizing

TCO



Reference: APC White paper #37

Reduced Waste from “Rightsizing”



Reference: APC White paper #37

InfraStruXure® Systems for Applications

- Small Footprint
- Pre-engineered System
- Factory tested
- Self Redundant
- Flexible
- Unity Power Factor
- Power and Cable Distribution
- Integrated Cooling
- Standard Components
- Rack Based Components

Defining data center efficiency

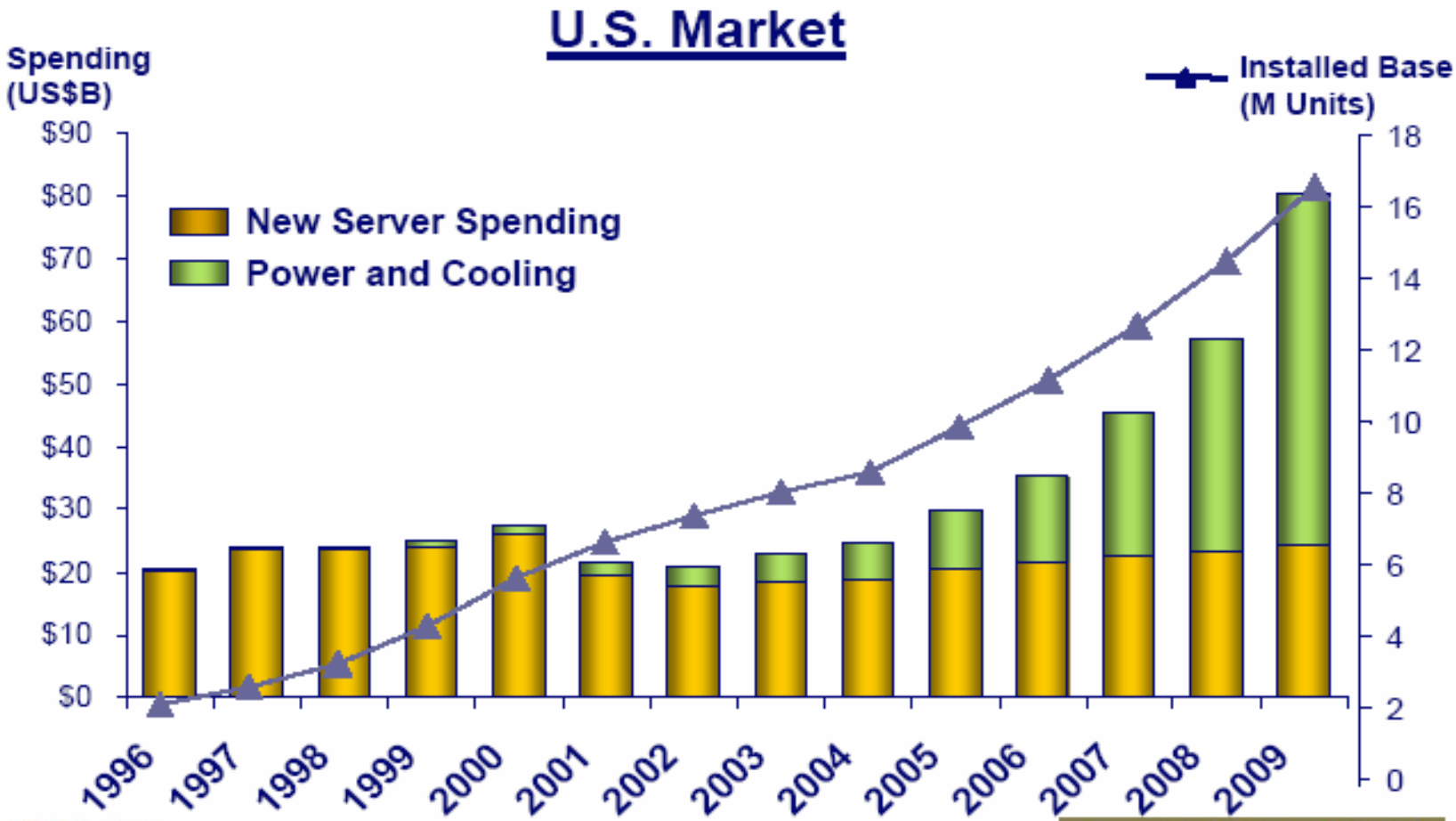
Data center infrastructure efficiency = $\frac{\text{IT load power}}{\text{Total data center input power}}$

DCiE

The percent of your input power that gets to the IT loads

The rest goes to power, cooling, and lighting equipment

Electrical consumption is the biggest issue with data centers

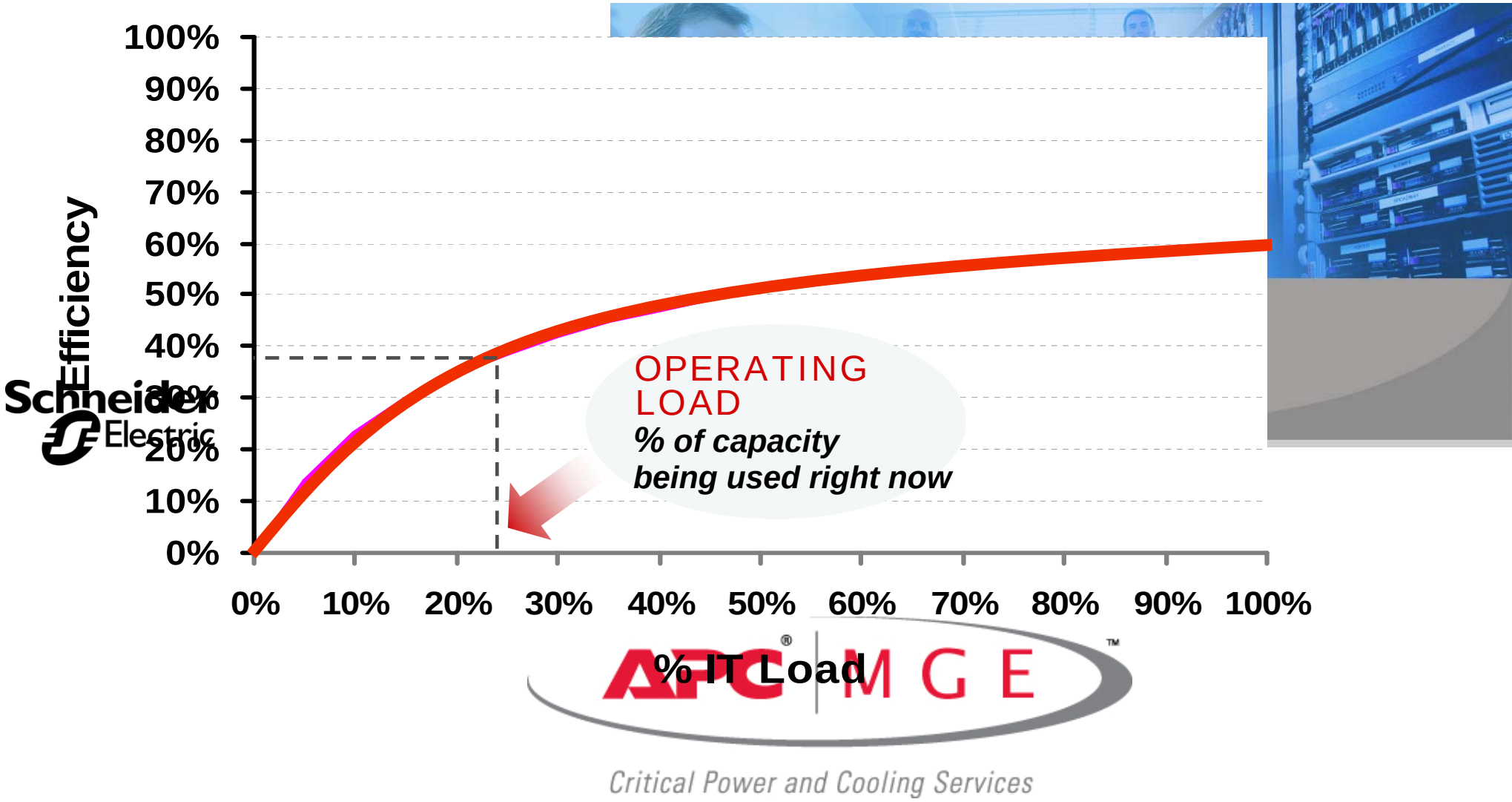


Purpose of efficiency measurement?

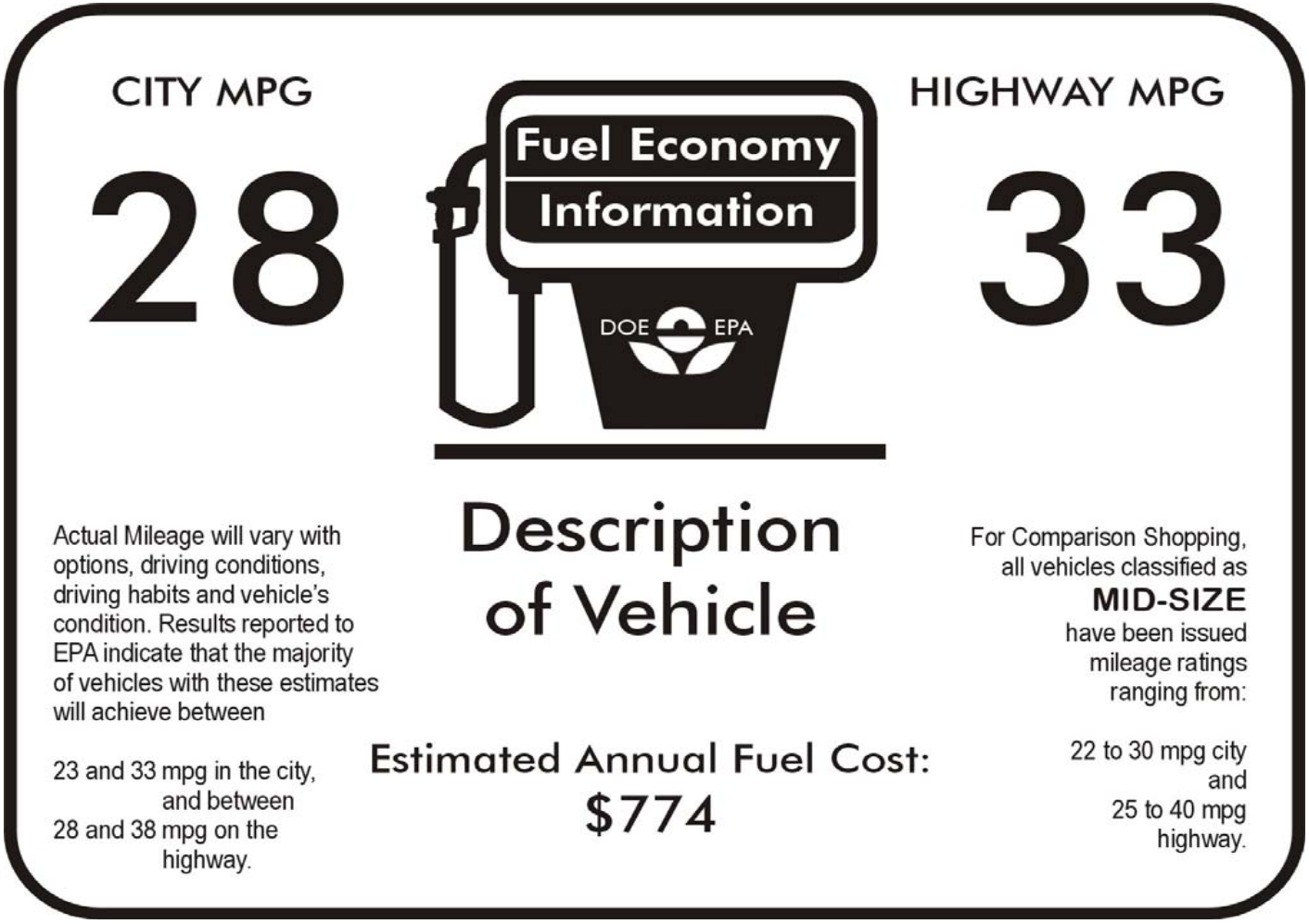
- **To benchmark**
- **To identify improvement opportunities**
  - **Poor performing equipment**
  - **Poor performing room layout**
  - **Inefficient operating settings**
- **To provide warnings and suggest corrective action when efficiency is degraded**
- **To determine best location to move a virtual IT load**

Efficiency measurement is NOT a spectator sport!
Measurement needs to inform and guide action!

Data center efficiency as a function of IT load

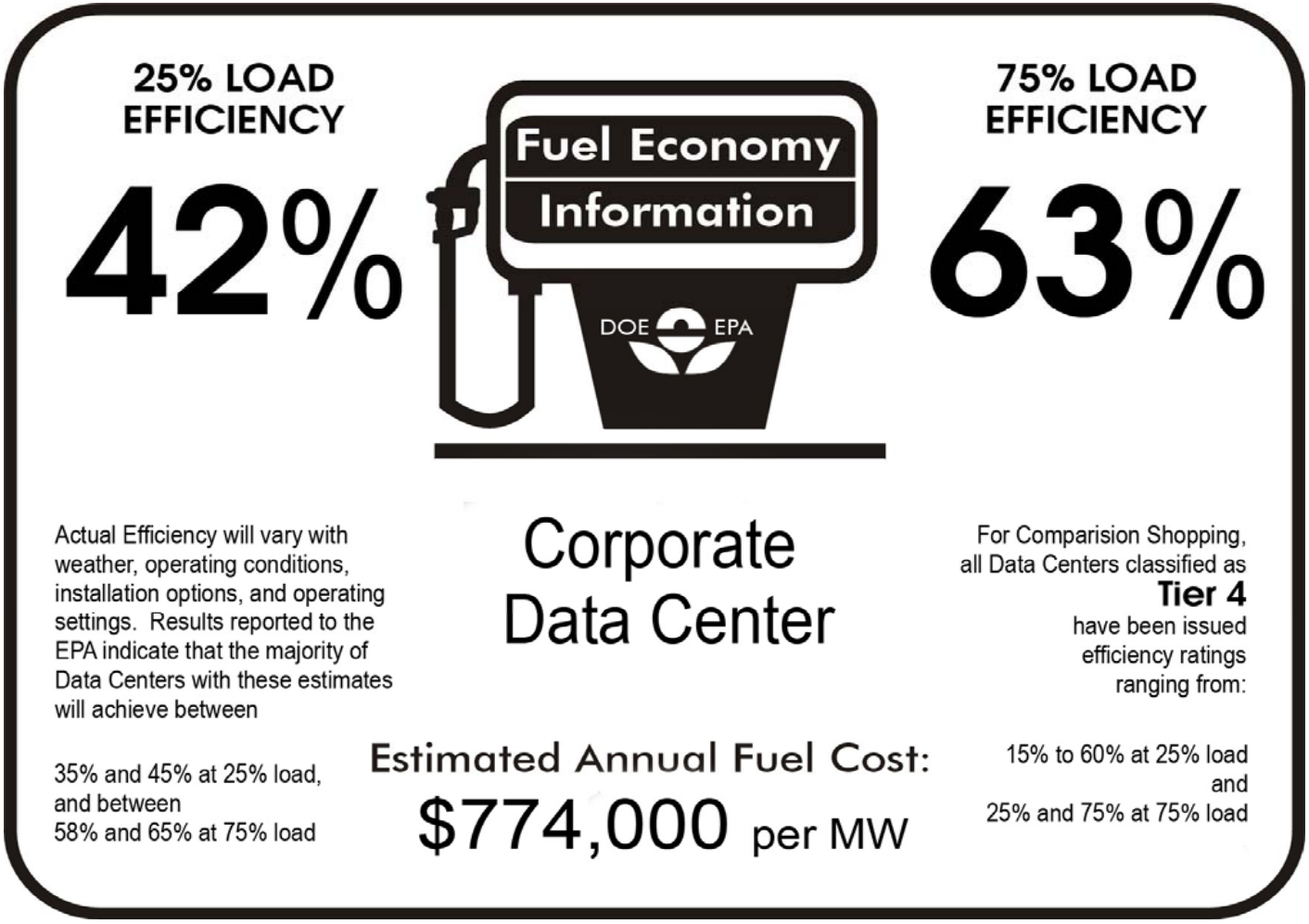


Efficiency rating for automobiles



Why Not?

Efficiency rating for data centers



Benchmarking data center efficiency

- **How to benchmark data centers against each other, when they have varying loads and conditions?**
- **How do you find a data center's efficiency at standardized test conditions?**

We cannot baseline, trend, or benchmark data center efficiency without data at standardized test conditions!

But we can't measure an actual data center at "standard conditions"!

- ***We can't force the IT load to a standard value***
- ***We can't force outdoor conditions to a standard value***
- ***In general, we can only test at the current data center operating conditions***

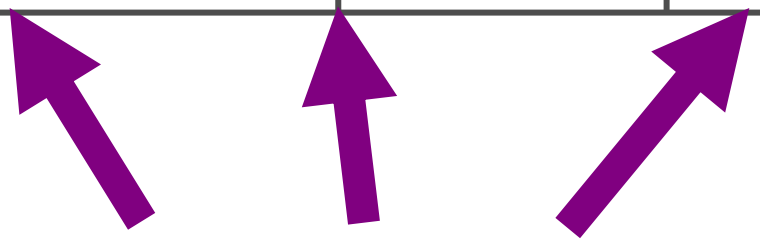
How to establish efficiency metrics under standard conditions?

- **We *can* make measurements at existing operating conditions**
- **We *can* use computer models to compute the efficiency at other operating conditions**
- **We can then benchmark designs against standards and against each other**

Efficiency performance of actual data centers

Standard IT load and outdoor temperature conditions

	Poor Examples	Typical	Best Practice
Tier 3 Data center efficiency	30%	50%	75%
Tier 4 Data center efficiency	20%	45%	70%



Where is your data center?

Sample statement of work
for an electrical efficiency assessment

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Statement of Work

Professional Services

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Table of Contents

1.0 Executive Summary

The Data Center Electrical Efficiency Assessment provides an analysis of the Power and Cooling systems to determine the operating efficiency of the complete system. In addition, the system is benchmarked against the expected values of efficiency based on the inherent design, and against other similar data centers. The projected efficiency under changing IT loads such as a growth plan, is calculated.

Our service professionals will provide an accurate assessment of the factors that are limiting the achievable efficiency of the data center and will make recommendations for changes to maximize efficiency. This will include:

- Assessment and analysis of the data center's as-built electrical efficiency
- Breakdowns of losses into power, cooling, and lighting losses
- Breakdown of the cooling system losses into CRAH, humidification, and outdoor heat rejection losses.
- Breakdown of the power system losses into UPS and power distribution.
- Creating and providing a mathematical model of the data center that can be used for benchmarking or scenario analysis
- Comparing the actual efficiency to the efficiency that should be expected based on the design, and identifying any constraints that are preventing the system for achieving its expected efficiency
- Detailed recommendations for improving the efficiency of the data center, taking into consideration the constraints of the facility

2.0 Features & Benefits

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Examples of different types of measurement instrumentation

Portable power measurement equipment (Fluke 435)

Permanently installed power measurement equipment (Power Logic PM700)

Built-in power measurement functions in cooling and power equipment (APC Symmetra UPS)

A cost effective energy management system uses a mix of these measurement approaches

What is the future?

- **Some local jurisdictions will establish penalties for low efficiency and incentives for higher efficiency, effectively making efficiency measurement mandatory**
- **Energy management will become a high profile objective of data center management**
- **Standardized data center designs with built-in real-time measurement of data center efficiency will become common**
- **Standardized data center designs with *system-level efficiency specifications* will become available**

Technology and design tools to dramatically increase data center power and cooling efficiency are available now!

- **Our Vision**

  APC MGE Products *ensuring availability* wherever data is created, transmitted or stored

- **Our Mission**

  To *create delighted customers* by improving the manageability, availability, and performance of information and providing a highly efficient infrastructure.

Thank You !!

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